

Is Clean Diesel Fuel an Option for Developing Countries?

- Why discuss Clean Diesel?

As proposals to reduce emissions from buses in developing countries are being discussed, several options have been proposed. Buses powered by natural gas have significant emissions benefits over diesel buses and are available right now. However, some have inquired whether advances in diesel engines and diesel engine emission control devices that require clean diesel fuel formulations might enable buses in developing countries to reduce emissions.

- Reducing Diesel Emissions Requires Clean Fuels and Advanced Emissions Controls

Efforts are underway to greatly reduce the emissions of diesel engines by all engine manufacturers. Natural gas engines have demonstrated the virtues of using a very clean, zero-sulfur fuel to reduce emissions.

However, if diesel fuel buses are to meet similar emissions performance, advancements in engine design and development of emission control technology cannot achieve the desired reductions without related changes to diesel fuel quality and composition.

At a minimum, ultra-low sulfur content diesel fuel is needed to enable effective emission control devices to reduce emissions of NO_x and particulates. Sulfur is a major impediment to implementation of the emission control technology needed to achieve significant emissions reductions from diesel engines and can even cause increased particulate emissions when used with advanced catalytic particulate control devices¹ designed to reduce emissions. Sulfur is also partly responsible for creating the brown color in the air from air pollution, and is a primary contributor to ambient particulate emissions. Sulfur reduction in the fuel without implementation of diesel engine emission control devices will have only minimal emission benefits.

- “Clean Diesel” usually means low-sulfur diesel

“Clean” diesel fuel is an imprecise term used to describe almost any diesel fuel that has been processed to reduce sulfur content or other “bad” actors to reduce particulate emissions (aromatic hydrocarbon content) or toxic emissions. The U.S. Environmental Protection Agency (EPA), in its latest proposed regulations for diesel engine emissions and diesel fuel, has proposed that diesel fuel have no more than 15 ppm sulfur content.² (Current U.S. regulations allow up to 500 ppm sulfur for diesel fuel used for highway transportation.) This is similar to regulations for diesel fuel in several cities in Sweden,

¹ “Overview of Diesel Emission Control—Sulfur Effects Program,” SAE Paper 2000-01-1876 by Wendy Clark, et.al., NREL, presented at the CEC/SAE International Spring Meeting, Paris, France, June 19-22, 2000.

² “Control of Air Pollution From New Motor Vehicles: Tier 2 Motor Vehicle Emissions Standards and Gasoline Sulfur Control Requirements; Final Rule,” FR 6697-6870, February 10, 1999 (Volume 65, Number 28).

Denmark, and the UK for “City Diesel.”³ The EU is currently in the process of deciding whether to implement a requirement that all diesel fuel have a maximum sulfur content of 50 ppm starting in 2005.⁴ This is in contrast to developing countries where diesel fuel sulfur contents of 1000 ppm or much more are common.

- Diesel has other contributors to emissions in addition to sulfur

The U.S. EPA has not yet proposed to regulate any diesel fuel property other than sulfur content, though research on toxics and particulate emissions may result in additional regulations in the future. However, the state of California in the U.S. has a limit on diesel fuel aromatic content, and City Diesel in Europe has limits on aromatic content and maximum boiling point.

- Low-sulfur diesel fuel is expensive to make

In most refineries, diesel fuel is made from distillate fractions of crude oil. Unless special processing is done, these fractions will contain sulfur in proportion to the sulfur content of the crude oil (i.e., high sulfur content crude oil will yield high sulfur content diesel fuel). In the U.S. ultra-low sulfur diesel fuel is being sold for about 10 cents per gallon more than conventional diesel fuel.⁵

- Producing low-sulfur diesel fuel in developing country refineries looks difficult and expensive

Most refineries in developing countries are relatively simple in that they do not have much or any hydrocracking capability which limits their ability to produce low-sulfur diesel fuel. Modifying refineries to add hydrocracking capability is expensive and may not be cost-effective compared with importing low-sulfur fuel. Neither of these options may be attractive to developing countries.

- Importing low-sulfur diesel fuel to developing countries is possible but undesirable

Low-sulfur diesel fuel is now only available in some parts of Europe and in southern California in the U.S. (though in limited quantities). “Synthetic” diesel fuel (made from natural gas) is available in South Africa. Transportation costs from the U.S., Europe, or South Africa are likely to add significant cost (five to 10 cents per gallon U.S.) on top of the higher cost to make the low-sulfur fuel.

Another impediment to this option is the lack of sources for clean diesel fuel. The EPA proposed regulations for diesel fuel would require all U.S. diesel fuel to be ultra-low sulfur diesel fuel by 2006. However, refining capacity in the U.S. is running near capacity, with little capability for export. ARCO in the U.S. has committed to producing ultra-low sulfur diesel fuel for several demonstration projects in the U.S., but their

³ “What is Diesel Fuel,” www.DieselNet.com. Copyright © Ecopoint Inc. Revision 1999.01

⁴ “EC starts a consultation on the need to reduce the sulfur content of petrol & diesel fuels below 50 ppm,” Source: European Commission May 27, 2000.

⁵ Presentations at the World Bus and Clean Fuels Conference, June 2000.

capability to export to developing countries is limited.⁶ As previously mentioned, other current sources of clean diesel fuel include Europe and South Africa.

- Without controls and inspection, a low-sulfur diesel program would likely fail
A major problem with either of these options is control of imports of diesel fuel that do not have low sulfur content. The emission control devices that need ultra-low sulfur content diesel fuel will be deactivated if exposed to high sulfur diesel fuel. This would have a devastating economic impact on bus owners to replace these expensive emission control devices. An extensive enforcement program would have to be implemented to keep high-sulfur diesel fuel from being used in developing countries because the economic incentives for its use would be high.
- The use of clean-diesel in developing countries appears to be many years away
As the use of clean-diesel grows in the United States and Europe, starting in 2005-2010, world-wide supplies should increase. Sulfur reduction technologies will become more available as well. But economic pressures may keep prices for low-sulfur diesel fuel very high and unreasonable for developing countries. A sulfur reduction program should be considered for the 2010-2020 timeframe.

⁶ “ARCO offers ultra low sulfur diesel in Southern California,” Source: ARCO December 16, 1999.